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AUTHOR Handberg, Roger; Xinming, Liu
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ABSTRACT

In the People's Republic of China, science and technology policy is directed by the state and is an all encompassing managerial system through which courses of action are determined. The Chinese Academy of Sciences (Academia Sinica), a national comprehensive research center was established in 1949 to train qualified scientists and technicians. The China Science and Technology Developmental Plan was promulgated in 1956. By 1962, the major goals of the plan had been accomplished. A second ten-year plan followed. In 1978, the Communist Party gave new directions to the science and technology community, and in 1983, the government apparatus implemented the National Long-Term Plan for Science and Technology, 1986-2000. The objective of this plan is accomplishing the modernization of agriculture, industry, national defense, and science and technology. The best way to describe the Chinese system for managing science and technology policy and its implementation is that it is a Chinese derivative of the 1950s Soviet managerial system. The State Council is at the top of the hierarchy followed by the Committee for Science and Technology of China, the Chinese Academy of Sciences, research institutions associated with the various ministries and committees, research and technology centers associated with the universities, and local research institutes. As an economically developing country, China must make hard choices as to resource allocations, especially personnel. Lack of trained, qualified personnel continues to be the biggest factor hampering development. Two charts and a 13-item bibliography are included. (JB)

Science and Technology Policy in the People's Republic of China: Organizational Structures and Processes

Roger Handberg
University of Central Florida

Liu Xinming
Academia Sinica, PRC

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Introduction

This paper represents the first step in a sequence of papers looking at the development of science and technology policy in the United States and the People's Republic of China. As a first step, the paper will focus primarily upon an organizational overview of the People's Republic of China's (PRC) approaches to S & T policy. Two subsequent papers will focus more explicitly upon the cultural and psychological dimensions underlying development of such policies and the processes by which such policies are developed. Even even in considering the organizational aspect, our focus will be primarily upon the Chinese structure with the United States system present primarily as a reference point.

Several factors make such comparisons both extremely difficult and fascinating to contemplate. One is the obvious differences which exist in terms of the respective economic and technological base of the two countries. Despite the political rhetoric, the United States still ranks as one of the premier industrial powers in the world (Nelson, 1984). The PRC is a country struggling to handle the traditional burdens of the underdevelopment: high population relative to resources, comparatively low economic productivity, and an agrarian economy with significant modern economic components embedded in the mix. More

intriguing for a comparative analysis is the completely different institutional context within which S & T policy is developed. China as a society continues in a historical tradition of centralized authoritarian rule of which the Communist Party is the most recent manifestation. Much of this authoritarianism is reminiscent of an earlier Soviet Union.

This tradition of centralized control contrasts most obviously in the area of economic policy where the United States has in recent years debated the necessity and/or contours of a national industrial policy (Zysman and Tyson,1983; Adams and Klein, 1982). Within the Chinese political context, the necessity for a national industrial policy goes almost without saying. The issues rather are how best to achieve the important economic goals set forth by the political leadership for whom S & T policy is an extremely critical component. Differences over how such long term goals are to be achieved can be seen in the recent political troubles which grew out of what are deemed changes necessary to implement a more effective industrialization and improved economic productivity policy. Resolution of those issues can go in several directions but the pressures in the direction of industrialization will probably win out over the long run.

S & T policy as we indicated is a continuing issue especially in the developed countries since its success or failure impacts on their relative position in the world

industrial order. For such societies, their goals are to seek a niche from which the particular country (e.g. the United Kingdom) can be competitive or else in a very limited number of instances (e.g. the United States, Japan, or the Soviet Union) be competitive on a wide spectrum of technologies (Warnecke and Suleiman, 1975; Johson, 1982). The latter option is becoming less viable for many countries because of start up and infrastructure costs. Creating the necessary infrastructure may be beyond their capability so the pressure is to specialize. Therefore, the current debates in the United States especially over such S & T policies have an edge to them not seen in earlier years. The continuing political struggles in Congress over the Japanese threat ("economic Pearl Harbors") reflect this phenomena in its more traditional guise: economic protectionism (Zysman, 1983). But unfortunately, S & T policies are being packaged in term of this immediate threat even when the connection is tenuous or the issue is not central to United States' economic well being (Cloud, 13 May 1989).

The developing countries on the other hand are also struggling to make suitable S & T policies to fit their particular national conditions and resources. Their goal is to develop indigenous technologies while successfully integrating the rapidly advancing S & T available from more advanced societies. The result can be a situation characterized by apparent incongruities. Societies can

operate successfully with the abacus at one end and the latest computers at the other. Handling the sizable stresses induced by such change is a very problematic event witness the events in Iran in the late seventies and more recently in China. In any case, the ultimate goal is to lift the country out of poverty and backwardness, a goal which Americans understand intellectually but not emotionally, the gap being that large.

In assessing the S & T policy process in China, the dominant characteristics which influence the development of policy are the fact that the country is a developing country with an enormous population (over one billion people at best estimate). This means that policy decisions regardless of where or how they are ultimately made take a long time to be successfully implemented. In fact, this size and concomitant communication problems means that policy implementation in China is essentially an onion model. Change takes place most clearly and successfully in locations close to the seats of power, more peripheral institutions change much more slowly if at all. Lack of resources minimize the likelihood of change, better to continue the status quo.

This slowness may be an actual reluctance to change but is more realistically embedded in the fiscal reality confronted by most local research and development facility heads. Resources are scarce and new resources are more likely to be given to institutes closer to the centers of

power. Why should an institute director commit scarce resources to a programme whose success is problematic at best and long term in scope while crippling present ongoing successful local S & T programs.

Also the more distant centers are more likely to contain the least well trained scientists and engineers. New technologies and procedures are beyond their capability without significant upgrading and expansion of their skills. The result is the proliferation of new institutions to supplement but not replace older existing institutes and labs. Such decisions are easier than overcoming the inertia of existing programmes and institutes. For example, in 1987, there were 9,153 research and development institutions in China (Committee of S & T of China, 1987: 259-60). These were controlled by a variety of specialized agencies, the Chinese Government itself, the various provinces, and by Ministries of the State Council. The possibilities for duplication are endless and continuing but not necessarily wasteful given the needs of the country. Redundant approaches may lead to solutions because each agency by default focuses upon a piece of the problem. The fragmentation can prevent a wholesale solution but that guidance must come from the national bodies.

As indicated above, this paper attempts to present an overview of the existing system - a system unlikely to change significantly in the immediate future despite current political turmoil.. One reason for this continuing

stability is that the existing structure is clearly under government control although there is some competition between the various components of the government. The competition is usually to establish bureaucratic boundaries in order to fend off other agency competitors. By establishing such boundaries, agencies guarantee their continued existence and the possibility of future expansion.

The paper is laid out fairly directly, the first section will focus upon Chinese definitions of S & T policy which is essentially a definition of power: who rules. Subsequent sections will give a brief historical overview of S & T policy in China and a snapshot of the organizational and governance structure of the existing system. In the latter context, we will discuss briefly the issues that confront the system and what projections one might make as to how to solve the very real problems and seize the opportunities that the Chinese people see in their future.

The Chinese Concept of S & T Policy

The definitions of S & T policy reported here reflect the particular climate within which government policy generally is made in China. The primary political concern is with insuring that no sector of the society get beyond government control. Acceptance of these parameters is assumed and failures are punished in a variety of ways.

1. S & T policy is directed by the state (Committee of Education, 1987: 25).

A simple statement but it embodies the reality of policy in China. There is no independent scientific and technological sector allowable within the context of Chinese society. The government is responsible for adapting policies to fit the changing historical conditions within which China operates. The amorphous American S & T policy environment does not exist where nongovernmental players often dominate policy development. Rather, nongovernmental players in the Chinese context are foreign entities whose involvement is subject to clearly defined limits and watched with some suspicion by government S & T policy agencies.

In one sense though, the process is rapidly getting out of the government's control. Introduction of more foreign scholars and internationally trained Chinese scientists and engineers can change the dynamics of the system in unanticipated ways. The ultimate impact will probably be less than immediate analysis would lead one to believe. The dynamics of change continue regardless of the political environment. China's economic needs will not disappear just because the leadership decrees it so. Real problems will require real permanent solutions else the system collapse completely.

2. S & T policy is an all encompassing managerial system through which courses of action are determined (Yang, et al., 1985: 130).

This policy is made by the state in order to achieve national scientific and technical tasks. The two

definitions are basically identical but Chinese analysts see the latter as making clear the total control assumed under the existing governmental system. The actual policy direction can come as indicated above from national, regional, and ministry-level S & T policies. The span of control encompasses both macro and microlevel policies but the distinction is not always clear. In fact, during certain historical periods by necessity, the central agencies may be heavily involved in microlevel policy making and implementation. The pressure on those responsible is to reach down into the existing system as deeply as possible in order to further national policies.

Balancing off the need for uniformity of implementation against meeting the exigencies of local conditions is a difficult one hampered at times by a changing political environment. Given the organizational ethos of a communist state, there are no truly independent sectors. Efforts to assert such a position are resisted but the pressures for such a de facto separation (not independence) grow as China attempts to modernize and move into the international economy in a more forceful and productive manner.

The fundamental dilemma is that of orchestrating a system that moves as one but has the flexibility to adapt to local conditions without losing the central direction of what is being sought. Developed societies have the same problems with a wide variety of solutions ranging from fairly extensive government intervention in certain specific

sets of policy areas to a more laid back approach where the government sees itself as reactive rather than proactive.

The last American presidential election saw skirmishes on the edges of this issue in the abortive discussions over whether the United States should explicitly establish an industrial policy. In fact, through jerks and starts, the United States is moving toward such a policy posture but the product is largely a conglomeration of wish lists rather than a thought out policy. Budgetary restrictions are forcing a number of agencies to increasingly move in alliance with their client industries toward some form of national goal setting rather than a blind reliance on market forces especially in high tech areas. Most of these areas are assumed to have some tenuous at least connection with national defense needs.

Historical Overview

On October 1, 1949, the People's Republic of China was founded with the ouster of the Kuomintang's Government and their exile to Tiawan. The Chinese Government immediately began to shape an indigenous system of S & T institutions under the control of the central government. Even in the beginning of the People's Republic of China, the Communist Party of China affirmed: "Science is a great revolutionary power which can push history forward and change society, and also save and change China." (Gong, 1986)

Subsequently, on November 1, 1949, the Chinese Government set up the leading academic institution for the

natural and social sciences - The Chinese Academy of Sciences (Academia Sinica). This national institution is the comprehensive research center with branches in several other major cities. At the same time as the establishment of the Academy, the restructuring and political remodeling of the higher educational system was implemented with primary emphasis upon the production of qualified scientists and technicians. In quantitative terms, the number of research institutes rose from 30 (before 1949) to 840 with scientific and technical personnel rising in number from approximately ten thousand to over forty thousand by the middle of the 1950s.. Even with these dramatic increases, severe personnel shortages continued especially in the most advanced disciplines. This lack of suitably trained personnel is a recurring issue within Chinese S & T policy as it is for almost all countries including the developed (Holden, 30 June 1989: 1536).

By the end of 1955, the Party Central Committee issued a call for a "march towards science and technology" for the people of the country as a whole. This call initiated the China S & T Developmental Plan which was promulgated in 1956. The process by which this plan was developed is typical of the policy planning process within the PRC. Various components of the national government and relevant research and educational institutions were brought together into what was termed the Committee for Scientific Planning of the State Council. The process of negotiation and

bargaining took about eight months. Three major documents came out of the process: "The China S & T Developmental Long-Term Plan, 1956-1967;" "The Directions of National Important S & T Tasks and Central Problems;" and "The Directions of Disciplines Plan of Basic Science."

The Developmental Plan which was the over-arching document within which the other two fit put forth 13 fields, 57 projects, and 616 central problems as the major thrust for the succeeding decade. This degree of specificity can be seen in some of the central problems specified. Examples of the thirteen fields include the peaceful use of nuclear energy (although the military implications were clearly recognized), development of jet technologies, study of seismology, and the study of electronics in various forms. Among the 57 projects were surveys of natural resources, studies of economic development possibilities for several regions, and developments relative to public health. Explicit studies were mandated to study photosynthesis and the use of microwave technology.

The Plan took about six million words to describe what was to be done. Equivalent documents from the American National Academy of Science are more succinct and vague in certain specifics. The negotiations in the American context often come after the report. Within the Chinese context, the negotiations are prior to the document's finalization. Implementation is assumed to occur on the basis of the

agreed upon statement which explains the high degree of specificity of some recommendations.

Several principles clearly underlie the Plan. First, the Plan was closely integrated with the actual practice of national construction (i.e. economic development). Secondly, the Plan was future oriented in that the Plan clearly looked forward to new technological advances while tied to basic theoretical research. Finally, the abstractions of the Plan were directly linked to concrete research tasks which concomitantly led to personnel training and recruitment plans in support of the basic goals.

The importance of these documents comes in two ways. First, the Plan plus its supporting documents was the first official statement concerning S & T policy as a separate policy domain. More importantly, the Plan gave clearly established goals and objectives against which progress or lack of progress could be measured. In order to more effectively monitor the progress achieved under the plan, the Committee for Scientific Planning was changed into a permanent body, the predecessor of the present national Committee for S & T.

By 1962, the major goals of the plan had been accomplished. New fields of work including semiconductor technology, computer technology, electronics and automation technology, and nuclear energy were well under development. For most of these areas, the major goals had been development of basic institutes and training technical

personnel. As is obvious, most of the areas had clear national defense implications, a factor of increasing importance due to the political split with the Soviet Union.

These accomplishments took place against a series of political events which had unsettling implications for the society. Dramatic changes in the political environment has been a recurring theme in Chinese history especially since the fall of Imperial China. This is accentuated in a political system characterized by elite rule - a small long standing elite whose crucial formative experiences were prior to World War Two. Chinese leadership struggles take place internal to the elite group but the ramifications often surface in terms of dramatic changes in public policy.

From 1958 to 1960, two movements were begun, one in response to the other. The first "The Great Leap Forward" was an effort to harness the energy of the people in overcoming China's backwardness. ~The vast population of China would be used as an asset - through mass action long standing problems would solved in a hurry. In intention, a short cut was sought to the goal of economic modernization. As part of this process, a loosening occurred in terms of political rhetoric and discussion ("let a thousand flowers bloom"). The resulting criticism and discontent voiced by segments of the population including some thought to be advanced in terms of political ideology led to the second movement, "Against Right Deviation." In effect, the recently loosened prohibitions on speech and thought were

reimposed in order to reestablish central political control. For certain elements of the leadership centered on Chairman Mao, the discontent uncovered was particularly disturbing since it indicated much work needed to be done in order to politically purify the country.

For the S & T community, the two movements had fairly serious consequences since leading scientists were among those subject to political reeducation when political control was reasserted. Several major research institutions were disrupted while a hiatus ensued in several major areas. The National Committee for S & T attempted to regain the momentum in 1962 by developing the second national S & T plan.

The second plan entitled "Ten Year Plan for S & T Development, 1963-1972 was developed in terms of three major components (Hu and Zhang, 1984: 2). The three components are: the Plan for Basic Sciences, the Plan for Technological Sciences, and the Plan for Disciplines. This set of plans was much more focused than the original since certain basic scientific infrastructures were assumed to be in place. For example, nuclear energy was still emphasized and represented by 18 projects - a reflection of the fact that it represented an important potential energy source in an energy poor country.

The outstanding characteristic of the second plan was a firm commitment to extending science and its methods to the problems of agricultural technology and production. Given

the close margins within which China operates relative to its food supply, such a thrust was to be expected. Until some greater stability in food production was achieved, any accomplishments in high tech industries were unstable and subject to drastic fluctuations.

This particular set of plans were seen within the Chinese S & T community as a high point which were washed out by the events of the next decade. From 1966 until 1976, the "Cultural Revolution" hit Chinese society with devastating effects upon S & T policy and program development. A generation of Chinese scientists and technicians were essentially lost with the effective closing of the research and educational institutions of the country. Older S & T personnel were placed in contexts where their productivity was destroyed or reduced to levels of ineffectualness. Large portions of the cadres were diverted into professionally inappropriate tasks, in effect wasting their training, or immersed in political education tasks which meant nothing was done. China is still recovering from the damage done during this period.

In March 1978, the Central Committee of the Party convened a National Science Conference at which new directions were given to the S & T community. At this conference, Mr. Deng Xiao-ping gave an important speech in which the political cadres in effect rehabilitated the scientific community and re-engaged them in national political development. Scientific and technical personnel

were declared to be part of the working class and thus dependable important forces in seeking national modernization. This declaration was important since it reversed the earlier position held during the "Cultural Revolution." Such a declaration was necessary in order to recapture the enthusiasm and loyalties of the scientific and technical classes who had been much battered by the past decade's political events.

In February, 1983, the government apparatus implemented the newest national S & T plan entitled the "National Long-Term Plan for S & T, 1986-2000." This Plan approved at the highest levels is the current plan for national development. The objective of the plan is accomplishing the modernization of agriculture, industry, national defense, and science and technology. The focal point is the development of what are characterized as high tech industries.

For example, in agriculture, the Government plans to harness the areas surrounding the Yellow, Huai, and Hai Rivers where grain production has lagged behind the needs or the country and the possibilities of modern technology. Seven fields were chosen as priorities in developing high technology components of the plan: biotechnology including genetic engineering, space technology especially space communications and rocketry, information technology with core being development of computer technology including electro-optics and lasers, energy technology including nuclear, ocean thermal and bio-energy, materials science

including ceramics and superconductivity, and automation especially manufacturing related technologies.

Many of these technologies are dominated by the industrial societies so that China approaches their development as a necessity if the country is fully utilize what is available elsewhere. Otherwise China will remain dependent upon what they see as unreliable providers, witness the earlier break with the Soviet Union and the controversies arising due to the recent political crackdown.

Obviously, recent political events may make the above scenario more problematic than envisioned in the plan. Whether there is sufficient momentum in the relevant technical areas to overcome the influence of events is unknown at this time and subject to drastic change over very short time frames. But, we think that recent events in China can not disrupt China's economic development including the leading edges of science and technology but temporary program short falls may be an acceptable price to the political elites.

Current S & T Policies.

In December 1980, the State Council convened a "National Conference on S & T Works" which centered its discussions on China's policies relative to S & T development. In April 1981, the Party Central Committee and the State Council ratified the new policy. The policy direction taken is that economic modernization is dependent upon S & T and that S & T work must be geared directly

toward economic modernization of China and the development of S & T must be explicitly well coordinated with economics and society. This policy attempts to balance off the needs for basic science and the requirements imposed by economic development. Therefore, projects the strengthen national productivity will be favored over more long term and problematic endeavors.

One consequence of this new policy initiative is that China opened its national frontiers to the international S & T community for the first time. This openness could be seen in two ways: the influx of foreign scholars into the country both on visits and on more long term research activities and the reverse outpouring of Chinese students to western universities and research institutes. Both methods are used in an effort to short circuit some of the personnel bottlenecks inherent in developing an modern scientific infrastructure. This openness was unprecedented in the context of Chinese Communist rule but reflects the elite perceptions that drastic measures were necessary in order to catch up with more rapidly developing neighbors such as Japan and South Korea never mind great power rivals, the United States and the Soviet Union.

Continuation of this openness is unlikely given the political necessities of the moment. Reassertion of political control outweighs other considerations in the short term. The real difficulty for Chinese authorities may come in absorbing those individuals who have already

returned or who still wish to return but whose technical training and expectations may be more advanced than supportable by local institutes and universities. Within the context of the total S & T structure, their numbers are fairly insignificant but they often are disproportionately important due to the fact that their selection for international training was a function of their ability. The best and the brightest may be the least useful in the short run due to continuing doubts about their political reliability. This dilemma has been a recurring one in Chinese S & T policy but is inherent in the political structure.

Managing the S & T Policy Process.

This section has the defect of being largely an institutional description of the PRC S & T policy process. One of the most difficult aspects of researching Chinese society and government is the outsiders' inability to acquire any meaningful information concerning the actual course of policy discussion within elite circles. Therefore, one is forced back upon more traditional descriptions of intensely personalized political struggles. Fortunately, the size and complexity of China makes such institutional descriptions not totally useless because so much has to be done bureaucratically because it is humanly impossible for a relatively small group of individuals to personally control events especially long term development

processes. They may create a crisis but its resolution may run out of their hands.

The dominant characteristic to describe the Chinese system for managing S & T policy and its implementation is that it is a Chinese derivative of the 1950s Soviet managerial system. The basic institutional structure was set under strong Soviet influence - a behavior pattern not broken even by the political struggles of the early 1960s. Essentially, the duality at the national level is that the political control is paramount so that the overall system is politically correct with the actual day to day management carried out by politically acceptable professionals. Concretely, this can be seen in the political control exercised by the State Council while the Committee for S & T of China (CSTC) exercises many of the managerial functions.

The CSTC was founded in 1958 under the direct supervision of the State Council. The CSTC's major functions are to plan on a national level S & T policy and to coordinate the actual implementation of policies. Procedurally, CSTC's major powers come from its active and continual involvement in development of all national plans and, more critically, its control over budget resources and their distribution to the various institutes and agencies. All provinces, municipalities and autonomous regions in the country have branches of the CSTC. Through this national presence, the CSTC has the ability to influence if not control events across the country. The very size of the

organization obviously at times limits its flexibility and responsiveness but the core goal is providing a national direction of policy which the CSTC does do.

When one shifts to the research active side of the structure, you confront five very distinct research structures which operate at different levels and with different agendas. Overlap and duplication exist because there is effectively no way by which to eliminate the problem. Also a multiplicity of competing institutions facilitates political control. Prestige-wise, the most visible set of research institutes operate under the auspices of the Chinese Academy of Sciences. This institution has the official responsibility for keeping China on the frontiers of science and technology within the limits imposed by the country's economic development. New scientific disciplines and technologies make their way into China through this organization.

Operationally, the Academy works through 122 scientific research institutes distributed across the country. Branches of the Academy itself have been set up in twelve cities. The work force involves over seventy thousand individuals of which over thirty five thousand are identified as associate research fellow or higher. The activities carried out by the Academy span the spectrum of science and technology as practiced in China.

In addition, the Academia Sinica has also a "General Assembly of Members," which is the nation's leading academic

advisory institution. Membership is the highest honor awarded to the nation's scientists and technologists. The four hundred individuals so honored are expected to actively participate in discussions and studies of the country's scientific and technological development problems as consultants and policy makers. This component of the Academia Sinica is clearly equivalent to the United States' National Academy of Sciences. In the American context though, there are no numerical limits to membership just scientific performance as judged by their peers.

Separate but related to the Academy are the research institutions associated with the various government ministries and committees under the State Council. The number of institutions is 932 (in 1986) with a work force of over half a million people. These institutes are important mechanisms by which more basic science discoveries are translated into workable technology within the Chinese economic context.

In fact, from a western perspective, this is the industrial component of the Chinese S & T system, in effect the applied end of the process (Committee of S & T of China: 1987: 263-67). Prestige-wise, these 932 institutes stand a level below the Academy but in one sense may be more critical to the ultimate successful economic development of China. Also through these institutes, western companies often get access to Chinese expertise in overcoming local difficulties in establishing production facilities

Even lower on the hierarchy are the several hundred research institutes and technology centers associated with the various universities. These institutions attempt to combine research and technological development work within the content of course work offered by the larger educational institution. The major difficulty here is that the numbers of students overwhelms the system while the universities as do western educational institutions struggle to keep current with leading edge technology. Away from the major population centers, technological obsolescence is a real problem for all institutions.

Lowest on the hierarchy are the local research institutes under the control of provinces, municipalities, and autonomous regions. These institutes which number over 3,360 (in 1986) work on problems related to the local government's wishes (Committee of S & T of China, 1987: 260-264). In effect, the institutes engage in direct policy relevant work of unknown quality. The numbers of workers is large but the impact is small compared to the more prestigious and comparatively well funded national institutions.

A large but unknown segment of the S & T system are those research institutes under the control of the departments of national defense and the industries of national defense. Other than to acknowledge their existence, there is no real published information on their activities including number of institutes and personnel.

Figure 1

About Here

Figure 1 attempts to capture some of the complexity described above of the Chinese system of S & T development. Even with the confusion inherent in the Figure, it is clear that much goes unexamined in terms of actual relationships between the various components of the system. Chinese S & T policy development and implementation still is best represented by a "black box" approach to many aspects of the system.

In concluding this section, we will attempt to sketch out the institutional processes by which S & T policy is formulated and implemented. There is a disembodied texture to the description because of limitations of direct access to the decision makers and no real policy analyses except as approved by political authorities. Bearing in mind these limitations, the Chinese system of management represents an interesting variation especially when compared to an advanced industrial society.

In a formal sense, the deputies to the National People's Congress and its standing committee are the ultimate authority for S & T policy within the Chinese society. The Committee (CSTC) has the dual function of both planning and funding the S & T activities of all functional units within the Chinese government. This span of activity runs both the academic research institutions and the more

industrial institutes associated with the various Ministries and Commissions under the State Council.

The State Council has operating under its auspices a special group called the S & T Leading Group for the State Council. The Group has the political function of coordinating, leading, and supervising all S & T work ithin the country. The major focal points of its activities are:

1. Examine and approve the S & T policies at the national level and specific policies from the various lower level organizations. The concern is that policies implemented by lower level agencies may have the practical effect of negating national policies or otherwise severely hampering successful national policy implementation.

In a country physically and population wise the size of China, the concern over inadvertent never mind deliberate obstructionism is a real one. The solutions are often not very successful because the answers can come too late or be too draconian in their scope. Subtle answers may be required but impossible to do given the distances and bureaucracies that have to be manipulated. The analogy might be made to a nuclear power technician forced to manipulate nuclear materials using television cameras and mechanical arms. Difficult but possible but requires complete concentration on the problem. In a bureaucracy, problems often slip out of sight to surface years later in another context.

2. Supervise the implementation of national S & T policies and national S & T legislation which means solving new and unanticipated problems that arise in implementing the policies.

Various provinces, municipalities, and autonomous regions formulate and implement policy for local S & T institutions and programmes while sub-units within the Ministries and Commissions make such policies for the industrial sector. All of these activities are in theory conducted under national program parameters as defined in national legislation adopted by the National People's Congress.

The central reality of the process as indicated earlier is that there is a dual system which typifies the conduct of government within China. The duality can be seen in that both the S & T Leading Group for the State Council and the CSTC formulate national polices and develop guiding principles for S & T legislation based on information collected from the various system subcomponents. The Leading Group represents the explicitly political component of the planning process while the CSTC approaches the issues from a more scientific technical managerial perspective.

Neither ignores the other but the political leadership in effect plays off the two perspectives and insures central government control over whatever policies successfully emerge from the process. The formal mechanism by which the two perspectives are resolved comes in the Government

Working Report which is presented by the Premier of the State Council to the National People's Congress.

Figure 2

About Here

Obviously, the skeletal outline above assumes that a research network exists by which information and policy recommendations can be solicited from the various components of the system. Formally, the policy research system consists of three components: the Party Central Committee and national research institutions, local research institutions, and learned societies specializing in S & T policy. The listing which follows (see Figure 2) only identifies the players but does not attempt to fully explain their particular roles, the intent is give some indication of the complexity of the policy process. The relative importance of particular groups is dependent upon the particular policy arena being contested. Some are much more specialized than others.

1. Party Central Committee and National research institutions:

a. The S & T Group of Policy Study, Secretariat of Party Central Committee

b. S & T Leading Group for the State Council

c. Research Centre of Economics, Technology, and Social Development for the State Council

d. Department of Rural Area Policies-Study for the State Council

e. Committee of Education, Sciences and Culture for the National People's Congress

f. Policy Bureau for the CSTP

g. Chinese Research Centre for S & T to Promote Development for the CSTP

h. Policy Bureau for the Academia Sinica

i. Institute of Policy and Management, Academia Sinica

j. Policy-Study Department for the Association of S & T of China

k. Chinese Research and Training Centre for Management Sciences for the Association of S & T of China

l. Policy Bureau of the National Natural Sciences Foundation

m. Chinese Academy of Management Sciences under Association of S & T of China

The Policy Bureau for CSTC, the Policy Bureau for the Chinese Academy of Sciences, the Policy-Study Department for the Association of S & T of China, and the Policy Bureau of the National Natural Sciences Foundation coordinate and manage studies concerning the making and implementation of national S & T policies. In addition, their role is formulate basic plans for such national policies and make recommendation to the State Council.

Recent examples would be the "Spark Plan" which uses technology to vigorously develop rural economies and which was implemented in 1985; or the "Torch Plan" which

formulates a strategy by which high technology achievements are translated into useful products (e.g technology transfer). This latter plan was implemented in 1988 while both were formulated by the CSTC as part of its overall responsibilities.

The Research Centre of S & T to Promote Development under the CSTC, the Institute of Policy and Management under the Academy Sinica, the Research and Training Center for Management Sciences under the Association of S & T For China, and the Chinese Academy of Management Sciences are professional research institutions concerning S & T policies. These institutions carry out mainly basic research along with advisory roles regarding S & T policy. A major function is develop the theoretical and methodological bases for existing policies and proposed changes.

2. Local Research Institutions

Generally speaking, the Policy-Study departments of the local research institutions are under the direct leadership of the local political subdivisions. Each government has the prerogative of developing its own policies along as those policies do not directly interfere with national policies and priorities. The effect is to allow local governments to tailor local institutions' priorities to reflect the felt necessities of the local region. Limitations on staff and resources clearly limit the

independence and skill with which this function is carried out.

3. The Learned Societies in S & T Policy

The major player among the learned societies in the S & T realm is the Chinese Society of Science of Science and S & T Policy. This institution has a clearly understood research and advisory role within the context of Chinese society. Established in 1978, the Society has established linkages to the Academia Sinica while its activities are directed by a consortium of institutions: the Academy Sinica, the CSTC, and the Association of S & T of China. In fulfilling its mission, the Society has branches set up across the country including some in ministries of the government. In a sense, the Society is a mechanism by which to tie together the diverse elements of Chinese society and government in this particular policy area.

The Society sees its role as that of basic research leading to specific plans to meet national priorities. More generally, the Society has striven to encourage study of the sociology of science, history of science and technology, S & T and society, technology assessment and transfer, environmental problems, energy problems, science indicators, and science infrastructure. As an umbrella organization, the Society fulfills the functions covered by a variety of organizations in the American context including the American Association for the Advancement of Science.

Conclusions.

The PRC has continued to grapple with the problems inherent in the economic development process. Advances and retreats in that process have occurred largely as a function of political events extraneous to the S & T policy process. As the economic and technological factors (forces) embodied in the concept of S & T policy become more central to China's economic development, the political authorities will find themselves forced to directly confront the dilemma of such developments. That dilemma is that high tech industries move to realms of interaction and sophistication beyond the ability of the political classes to understand or control beyond a rudimentary level. For example, the diffusion of computers and the associated technology undermines control in a manner that political authorities find frustrating. Too tight a control means nothing happens, looseness leads to chaos in their view.

"The Two Cultures Hypothesis" argued in the 1950s by C.P. Snow has become even more real at the end of the twentieth century. Much of science and technology especially at the high tech end is beyond the knowledge base of political leaders. In fact, much of the work deals in phenomenon which are almost counter intuitive for laypersons. In fact, the acceptance of much of high tech is a leap of faith for the politicos. This canyon of difference is accentuated in a political system where political loyalty overrides other considerations. For the Chinese leadership, ;the key to control will continue to be

the dual system developed originally by the Soviets and adapted to Chinese conditions.

Short term political events should not obscure the fact that policy processes are in place and working. China operates now in the context of its third national plan - a plan much more focused on the high tech end than ever before. This focus reflects the fact that China has achieved much beyond its original faltering steps in the 1950s. As with other developing countries, China must make hard choices as to resource allocations especially personnel. Trained qualified personnel continues to be the greatest deficit hampering development. Time and systematic commitment of the necessary resources is the only solution. How these decisions are arrived at (from the perspective of the outsider) is the next in the series of papers.

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Figure I.

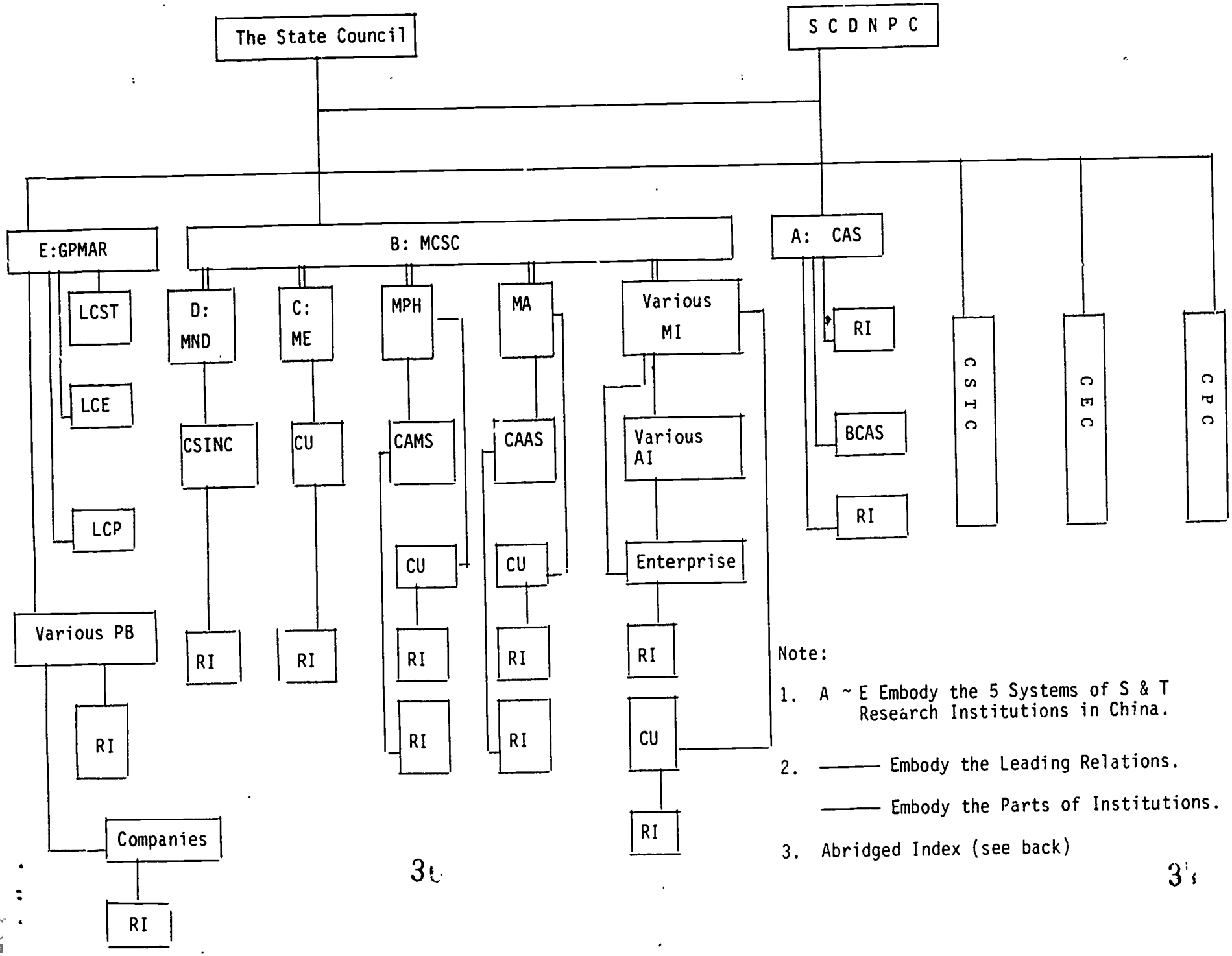
The State Council
S C D N P C
E:GPMAR
B: MCSC
A: CAS
LCST
LCE
LCP
D: MND
C: ME
MPH
MA
Various MI
RI
C S T C
C E C
C P C
CSINC
CU
CAMS
CAAS
Various AI
BCAS
RI
CU
CU
Enterprise
Various PB
RI
RI
RI
RI
RI
RI
RI
RI
RI
Companies
RI
CU
RI
Note:
1. A ~ E Embody the 5 Systems of S & T Research Institutions in China.
2. ——— Embody the Leading Relations.
——— Embody the Parts of Institutions.
3. Abridged Index (see back)

Figure I. Abridged Index

AI--- The Academy of Industry

BCAS--- Branches of the Chinese Academy of Sciences

CAAS--- The Chinese Academy of Agriculture

CAMS--- The Chinese Academy of Medical Sciences

CAS--- The Chinese Academy of Sciences

CEC--- The Committee of Economics of China

CPC--- The Committee of Plan of China

CSINC--- The Committee of Science and Industry of National Defence

CSTC--- The Committee of S & T of China

CU--- The Colleges and Universities

GPMAR--- The Governments of the Provinces, Municipalities and Antonomous Regions

LCE--- Local Committee of Economics

LCP--- Local Committee of Plan

LCST--- Local Committee of S & T

MA--- The Ministry of Agriculture

MCSC--- The Ministries and Commissions under the State Council

ME--- The Ministry of Education

MI--- The Ministry of Industry

MND--- The Ministry of National Defence

MPH- The Ministry of Public Health

PB--- The Professional Bureaus

RI--- Research Institutions

SCDNPC---The Standing Committee of Deputies to the National People's Congress.

Figure II.

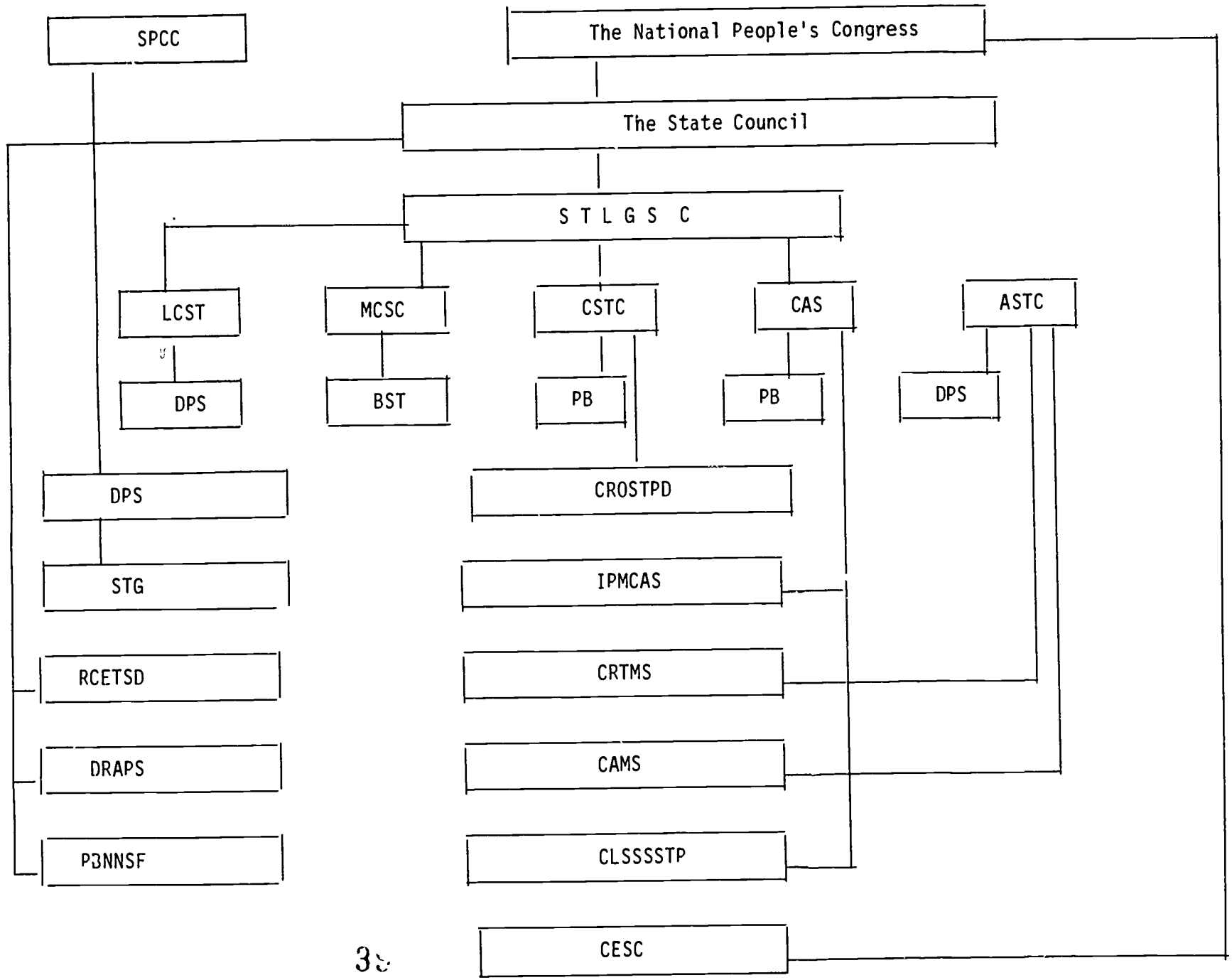
SPCC
The National People's Congress
The State Council
S T L G S C
LCST
MCSC
CSTC
CAS
ASTC
DPS
BST
PB
PB
DPS
DPS
CROSTPD
STG
IPMCAS
RCETSD
CRTMS
DRAPS
CAMS
P3NNSF
CLSSSSTP
CESC

Figure II. Abridged Index

ASTC---	The Association of S & T of China
BST---	The Bureaus of S & T
CAMS---	The Chinese Academy of Management Sciences
CAS---	The Chinese Academy of Sciences
CESC---	The Committee of Education, Sciences and Culture
CLSSSSTP---	The Chinese Learned Society of Science of Science and S & T Policy
CRCSTPD---	The Chinese Research Centre of S & T Promote Development
CRTCMS---	The Chinese Research and Training Center of Management Sciences
CSTC---	The Committee of S & T of China
DPS---	The Departments of Policy-Study
DRAPS---	The Departments of Rural Area Policy-Study
IPMCAS---	The Institute of Policy and Management for the Chinese Academy of Sciences
LCST---	The Local Committee of S & T
MCSC---	The Ministries and Commissions for the State Council
NPC---	The National People's Congress
PB---	The Policy Bureau
PBNNSF---	The Policy Bureau of the National Natural Sciences Foundation
RCETSD---	The Research Center of Economics, Technology and Social Development
SPCC---	The Secretariat of the Party Central Committee
STG---	The S & T Group
STLGSC---	The S & T Leading Group for the State Council